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From the Author

ON THE MEDITERRANEAN
COAST OF THE SOUTH OF FRANCE
IN ITS MEDICAL ASPECT

WITH A REPORT OF METEOROLOGICAL OBSERVATIONS MADE AT CANNES

FROM NOVEMBER 1, 1874 TO APRIL 30, 1875

BY

W. MARCET, M.D., F.R.S.

LONDON
LONGMANS, GREEN, AND CO.
1876



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*IN ITS MEDICAL ASPECT.*¹

INTRODUCTION.

ON HEAT A POWER OF MOTION IN THE LIVING BODY
IN HEALTH AND DISEASE.

HEAT is a mode of motion of matter and a power for change which applies to the living animal body. We consider heat as the result of a vibration or motion of matter, which may be developed by friction, percussion, or compression; its most important seat of formation being the sun. When matter becomes heated, a portion of the heat is tangible, either to our feelings or to the thermometer, and in a fit state for performing actual work, when it is known as *potential*; another portion of the heat, being employed in pushing asunder the atoms of matter, is not sensible to the thermometer, and remains latent or *powerless* to do any other work, until given out in the potential form. Water, for instance, whose capacity for heat is great, may feel cold to the touch, and yet have in store a considerable amount of heat fit for work under those

¹ The Introduction and three first chapters are reprinted from the 'British Medical Journal,' 1875.

conditions which promote the evolution of this heat in the tangible and active state.

Dr. Tyndall, whose highly instructive and interesting work on 'Heat a Mode of Motion' has suggested to me the remarks embodied in the present introduction, gives an excellent illustration of the passage of heat from the latent condition into the tangible or potential state. A supersaturated solution of sulphate of soda is prepared by allowing to cool, undisturbed, a solution of this substance in hot water. The fluid holds in solution a greater quantity of the salt than the water could contain when cold, except if kept in a state of perfect repose; on dropping into it a crystal of sulphate of soda, crystallisation immediately sets in. Shortly afterwards, a thermo-electric pile, placed in communication with the fluid, will indicate heat by its deflecting action on the needle of a galvanometer. This heat is precisely the same in amount as that which the crystals had abstracted from the hot water in order to dissolve, and it is given out on the crystals forming afresh.

Now, all vegetables absorb heat during growth; this heat is derived from the sun, but, being used up in the work required for the nutrition of the plant, it remains latent or concealed within the substance of the tissues. When a log of wood is burnt in our fireplace, the amount of heat it yields is precisely the same as that which it had originally taken from the sun for the work necessary to its growth, so that the heat given out in an hour from a piece of burning wood may have taken years to accumulate within it.

Heat, consequently, is a power which becomes bottled up, if I may so express it, by the object on which this power has been exerted; not that heat is any particular material, but it is used to build up the molecules of the *object*, and keep them in certain definite relations to each other. It is equally present in a definite quantity in our food, whose carbon and hydrogen yield it when their attraction for oxygen comes into play. Heat thus libe-

rated becomes potential, and must expend its energy in one way or another. It is to this phenomenon that the temperature of living animals is due; this heat exerts its power, partly by effecting the various functional changes which are constantly in progress in the body, partly by ministering to muscular movement. Consequently, the various processes on which depends the maintenance of life are a source both of liberation and of consumption of heat; the liberation being due to oxidation, the consumption to the work the heat has to perform in the body—a phenomenon necessarily attended with cooling. In addition to this production of cold, temperature is abstracted by radiation from the body, which must keep drawing upon food for a continued supply of heat. It follows that food has two great objects to secure—that of yielding material to be transformed into tissues, and that of imparting heat, and consequently power, for the due performance of the functions of life.

There is, however, another source of animal heat which must be more effectual than is usually considered to be the case, namely, the direct action of the sun. In tropical climates, this agent undoubtedly acts an important part towards the performance of the animal functions; indeed, heat cannot be derived in sufficient amount from food where a pound or two of rice taken daily are sufficient to keep up life, as we find is the case with the natives in Bengal. Again, I need not allude to the frequent necessity of using artificial heat shortly after birth, when the body can hardly maintain its own temperature.

A certain class of invalids proceed every year, about the beginning of November, to the shores of the Mediterranean and various stations in Egypt and Africa, there to enjoy a mild winter with a bright warm sun, and, not unfrequently, a succession of fine days lasting for two or three months, or even longer, with but slight interruption. Here they can walk and drive out every day, even in the middle of winter, which is cheated out of its fogs

and drizzling rain, its cold, cutting winds, and snow storms. But, if a weakened state of health be benefited by such a change of climate, I may be allowed to doubt how far healthy and robust persons will be the better for wintering in the sunny South. It must be remembered that the succession of the seasons in northern latitudes is in many respects an advantage in a sanitary point of view. In winter, the functions of the body undergo a kind of repose or rest; there is less heat and light, and consequently less activity in the vital phenomena; this we are unconscious of; nevertheless, there can be little doubt that it is so. The hibernation of certain animals is due to a torpid condition of all their functions; again, when the air is very cold, and the body exhausted by muscular exercise, or weakened from want of food, a feeling of drowsiness and numbness creeps on, clearly indicating a failure of vital power, which can only be restored by the external application of warmth and the administration of food. After the disappearance of snow and ice, when, in the early spring, nature appears to waken afresh and rejoice in the bright warm rays of the sun, human beings and animals are equally conscious of a renewal of life, energy, and strength. Those who winter in the South, in search of a temperature which the weakened functions of their body may require, must recollect that, let the station they select be ever so healthy, a warm climate has the tendency of lessening the power the body possesses of generating heat; consequently, cold, even to a moderate extent, will be felt much more keenly by them than it would in a colder country. Few escape a chilly sensation on the coast of the Mediterranean, when, after being out in the sun at a temperature of 65 deg. Fahr., a spot in the shade is reached at a temperature of 52 deg. Fahr. (readings observed on January 30, 1874, at noon). This feeling of cold results, not only from contrast, but in a great measure from the fact that the body is deprived, by the continued influence of a mild winter season, of the power of producing the necessary amount of heat when

in the shade. It becomes accustomed to rely upon the sun for the temperature it requires for the performance of its functions, and, when no sun is to be had, a feeling of cold is at once experienced.

What are, therefore, the best means of preserving health in a warm winter climate? As so much heat is derived from the direct action of the sun in the daytime, it will be important to restrict the heat-generating power of the body by taking but a moderate amount of food; moreover, as the sun's heat must be productive of motion in the body, commencing probably with an increased action of the heart and excited state of the circulation, it is advisable to avoid any additional stimulation, such as that which would result from alcoholic beverages, in any but very moderate quantities. Invalids wintering in the South of France should be careful not to sit down in the sun, however tempting this may be; it is much safer for them to keep walking on slowly, watching the ripple on the water of the Mediterranean, or the foam as it blows about in a gentle breeze, or the waves as they curl over gracefully breaking in regular succession upon the beach. The main point is to give the heat absorbed a sufficient quantity of work to do in the body, so as to use it up; otherwise it is pretty certain to do mischief. Hence a moderate degree of muscular exercise, while out on a hot sunny day in a warm climate, is beneficial. It is true that muscular exercise, although it requires heat for its performance, also promotes the formation of heat by exciting the circulation and respiration, thereby causing the consumption of an increased quantity of oxygen; but muscular movement must, it appears to me, begin by making use of the heat obtained directly from the sun, which is within immediate reach, thus lessening the necessity for heat-production by the body.

A high temperature of the body in disease is probably owing to the united action of a number of different causes. In fevers, the total amount of urea excreted and the quantity of carbonic acid expired, being greater than

under normal conditions, it is usually thought that increased oxidation is the source of excessive heat. Now, under normal circumstances, the amount of food taken is considered as regulating the excretion of urea; and consequently, in health, a great excess of urea may be formed without any rise of temperature. This oxidation-process, consequent on the ingestion of food, must be a source of much heat in addition to that formed while fasting, and which is clearly taken up by some function also related to the ingestion of food; otherwise the body would necessarily become warmer. The function thus supplied with potential heat must be that of *nutrition*, which I consider as including all the phenomena connected with digestion and the formation of tissues. By taking food after fasting, or increasing the amount of food taken, an additional formation of heat is produced, together with increased nutrition; and the amount of heat generated must be exactly proportional to the degree of nutrition necessary for its consumption. In fevers, where the function of nutrition is nearly in total abeyance, the rise of temperature appears to me to be due mainly, if not nearly entirely, to arrested nutrition, while the formation of urea and carbonic acid in the body continues. Two years ago Professor Sanderson chose the subject of 'febrile processes' for a communication in Holmes' system of surgery. He then attempted to show that the commonly accepted notion that fever is a condition of the organism in which chemical processes go on to a greater extent than in health, is erroneous, and opposed to facts; for, when actually measured, fever is found to be a state of the organism in which the mechanism is hampered and its power impaired or diminished.—Dr. Sanderson 'On the Process of Inflammation,' *'Lancet,'* January 1, 1876.

Wunderlich suggests a similar idea in his work on 'Medical Thermometry' (translated by Dr. Bathurst Woodman). He states (p. 193): 'A general elevation of temperature may also occur through an extensive over-production of heat, resulting from chemical processes which

are more or less unknown in the healthy body, by means of which so much heat may be generated that the channels of heat-abstraction are quite unable to compensate it; whilst in these also, through the extension of the disturbance, irregularities and anomalies may be developed. Very much, indeed, may be said for this; and something of this sort occurs in very many cases of fever.'

The excess over the normal degree of oxidation (supposing the heat resulting from this normal degree of oxidation to be absorbed or used up) is apparently insufficient to account for the excessive heat in fever. Wunderlich (p. 193) clearly expresses his opinion that such is the case, and that the weight, actually lost by the body in fever, does not correspond with the amount of destruction of the constituents of the body which might have been preconceived as resulting from the increased production of heat. Murchison, in his admirable treatise on the 'Continued Fevers of Great Britain,' remarks (p. 15): 'The preternatural heat of fever is the result of vital and chemical action exalted above the standard of health, assisted perhaps by a disturbance of the processes by which heat is carried away.' He therefore suggests a possible cause of increased temperature which is usually little thought of, namely, the lessened consumption of heat in the body.

Indeed, the more I look into this subject, the more it is apparent to me that the diminished activity of the various functions in disease, while urea and carbonic acid continue being formed, is the principal cause of increased temperature of the body.

This excess of animal heat in disease, which is commonly considered only as a symptom, is necessarily a serious cause of morbid action, as it must be employed in doing work. A portion, it is true, is lost by radiation, but the remainder may be considered as a source of motion; and, as most of the functions are in a state of abeyance, this agent will exert its power on the heart, and perhaps be a means of exciting abnormal changes in

the blood and tissues. It is therefore of much importance to effect, if possible, a reduction of the temperature in diseases attended with increased heat of the body; and, without entering at present into the merits of cooling baths, the rule for attaining this object must be to aim at increasing the various secretions, taking care lest they should be productive of too great a drain upon the system. Thus purgative medicines will be useful by causing heat to be absorbed towards the formation of the intestinal secretion; and I believe this is the explanation of the beneficial action of purgatives in many different affections and minor complaints. Again, Turkish baths and vapour baths, and the various means of promoting perspiration, will be advantageous, by causing an absorption of the amount of heat necessary to the increased exercise of this function. Any method calculated to bring on free perspiration, without requiring the use of heat, may be expected to prove one of the most efficient agents for lowering the temperature of the body in disease; and on that account I feel assured that no means of diaphoresis is so effectual as the application of the wet sheet. The well-known fact, that a return of perspiration frequently succeeds in reducing the temperature and lessening the action of the pulse in febrile affections, is a strong argument in favour of the view I am advocating.

I might continue adding largely to the present remarks, but hope they will suffice to show the importance, towards the maintenance of health, of endeavouring to transform the sun's heat into motion in the body, and also to draw attention to the cause of increased temperature in disease, together with the means of counter-acting its effects, by transforming the excess of heat, or at all events part of it, into physiological motion.

CHAPTER I.

SELECTION OF A WINTER STATION NEAR THE MEDITERRANEAN. USUAL CONDITION OF CONSUMPTIVE PATIENTS WHO WINTER IN THE SOUTH. BENEFIT EXPECTED FROM THE CLIMATE.

THE present subject has lost, I fear, some of the freshness and attraction it used to possess, from the extent of its literature. My apology in troubling the reader on the present occasion is a desire on my part to point out the resources of the Mediterranean coast in a medical point of view, and especially to show to what extent a winter residence in the sunny South can and will benefit those who suffer from consumption. I shall in no way propose to establish the comparative merits of any particular locality, but endeavour to point out and insist on certain rules which, in my humble opinion, might be useful in the selection of a winter-station on or near the Mediterranean coast. A residence of over four winter seasons on the Riviera has given me a fair number of opportunities of judging of its climate, and its influence on the progress of disease; hence in the following pages I am writing from personal experience.

The usual circumstances inducing, on the part of a medical adviser, a recommendation to winter in the South, will probably be first of all the fact that his patient is, at home, invariably worse in winter than in summer. This will apply, amongst other affections, to chronic cases of phthisis, or cases of threatened consumption, chronic bronchitis, asthma, debility from long continued rheumatism or gout. Many patients apply to us in some of the usual resorts on the Mediterranean coast, broken down in health from business, anxiety, or mental work. The tide of invalids moving south in November, and northwards again about the end of April, brings with it sufferers of every description, in fear and trembling of

cold, which, indeed, their weakened frame has no power of resisting. They leave home upon the first signs of autumn setting in, with the enjoyable prospect of country life in winter, and exercise in the open air under a bright sun, and without either frost or snow, or hardly any.

It is with consumptive patients that we are mostly concerned, and to that class of sufferers let us now turn our attention.

A certain number of those who come to us for medical advice are anxious to avert an attack of bronchial inflammation, which might lead to the softening of a pneumonic deposit. The applicant may be in apparent good health, strong, able to go about, and fairly full in flesh, although exhibiting a suspicious dulness at one apex, and perhaps some slight laryngitis, attended with a purulent secretion. He or she has been seen by several medical practitioners, and, after obtaining varying opinions, is advised to go south, rather as a means of precaution than with any other object in view. These patients reach their destination often considering themselves in perfect health; and, acting upon that erroneous assumption, subject themselves to many risks, or rather dangers, joining dinners and evening parties, and taking no precautions against the powerful rays of the sun or the sudden cold at sunset. The result is an attack of hæmoptysis, and the disease assumes at once a very serious aspect. If, on the contrary, on arrival, a residence be taken up in a proper locality, and certain restrictions strictly observed, the case will, in all probability, do well, the patient returning home in the spring with many a pleasant recollection of his winter season abroad.

Another class of phthisical subjects frequently appear amongst the winter visitors in the South. They have had one or more attacks of hæmoptysis, and are troubled with more or less shortness of breath, especially on going up hill; still they appear in a very fair state of health. An enquiry into the physical signs of their chest reveals a

harsh respiratory murmur, perhaps some fine crepitation in one or both lungs; while the low and indistinct sound of the murmur shows a deficient supply of air to the pulmonary organ. On percussion, no dulness whatever can be detected. Cases of this kind appear to me as instances of deficient nutrition of the pulmonary tissue, with temporary congestion of the lungs. As a rule, patients exhibiting these symptoms fail to progress satisfactorily at the seaside, where a return of the hæmoptysis is always to be dreaded; but they do well on the hills which skirt the Mediterranean coast, at an altitude of from fifty to four or five hundred feet above the sea. On condition of their selecting such a place for their winter residence, and observing certain rules of hygiene, the hæmorrhage is much less likely to return, while strength and the general state of health will improve materially. The prognosis in these cases is very uncertain: some of them recover to a very great extent;¹ others remain in the same state. They reappear in the South year after year, with an account of several fresh attacks of hæmoptysis, but looking much the same as in the previous winter. The physical signs do not vary, the same harsh respiratory murmur or crepitation either at the apex or the base being observed.

It may be, however, that the physical signs of simple congestion, or what I imagine to be a state of deficient nutrition, have another meaning, and are symptomatic of tubercular disease, even without the occurrence of dulness on percussion. Harsh breathing and fine crepitation are but a variety of one and the same sound; and fine crepitation at one apex, without any dulness, may certainly be a sign of incipient phthisis. In such instances the seat of the abnormal sound is an important consideration. If it be heard at the base of one or both lungs, the inference will be a state of temporary congestion; while

¹ Although in my original communication I allude to the possibility of a perfect recovery, still it is difficult to say how long the liability to hæmorrhage may last.

the same appearance at the apex will rather favour the idea of early phthisis; and here the thermometer comes into use as an important diagnostic means. In case of an increased temperature of the body and quick pulse, the object of the treatment must be to check these symptoms with as little delay as possible. Should they persist, the weight of the body will usually be observed to fall off rapidly, together with muscular power, the function of nutrition participating in the general state of debility; and diarrhœa setting in will, of course, seriously complicate the treatment of the case. These various changes for the worse may occur without any dulness on percussion of the chest supervening, and without there being much alteration of the physical signs in other respects. Under favourable circumstances, especially if the patient be sent up to the hills, a great change for the better will ensue, the accessions of heat becoming less severe, shorter in their duration, and perhaps entirely disappearing, while the pulse is reduced in frequency. Strength returns, appetite improves, food is taken with relish, and readily digested. These cases of phthisis return South on the approach of winter, a little thinner, a little more anæmic, than the year before. Still they keep on, till we hear of their fatal termination in summer or in autumn. The progress of the changes in the lungs is very difficult to trace from the physical signs. In one case which I have closely observed for two successive winters, the most careful examination showed no consolidation or softening. The cough was very urgent, accompanied at times with severe attacks of spasmodic dyspnœa; and the patient died in England four months after I had last seen her. Diarrhœa had set in some months before, and I was informed that a cavern in her right lung had been diagnosed when she died.

In some cases, I really do believe that hæmorrhage may be the cause of phthisis, but not unless a phthisical disposition exist in the patient.

We are constantly asked on a first visit, and naturally

enough, what amount of benefit we expect a patient to derive from the climate of the South; and how difficult it often is to give a positive answer! Suppose just such a case as that last considered: we must rely on its history, age, hereditary tendency, pulse and temperature, state of other organs, and general health; as the physical signs of the chest belong, perhaps, to simple bronchitis. The age, condition of the organs of digestion, and muscular power, may yield, however, important indications towards the object in view. 'Age,' according to Dr. Pollock ('Elements of Prognosis in Consumption'), 'must enter as a distinct element into all our calculations regarding the prolongation of any chronic disease, or the duration of the pauses between the attacks, which we have been noticing.' Again, Dr. C. T. Williams (*Med. Chir. Trans.*, vol. lv.) remarks, that the duration (of consumption) is longer in proportion as the age of the attack is later; the retarding influence of age being more conspicuous among males than among females.

I need not insist upon the importance of taking into consideration the state of the organs of digestion and of muscular power. A failing in these functions, although perhaps unattended with any change in the physical signs, is invariably an indication of a downward tendency; and the weighing-chair, which tells no tales, will at once detect a falling off in the weight of the body. This last remark not only applies to obscure, but to all cases of phthisis.

We have to consider, finally, the state of pulmonary consolidation with softening, and also that attended with cavities in the lungs. One of the earliest cases I had during my first season in the South (Nice, autumn 1871), was that of a lady aged about thirty-five, whom I found very much fatigued with the journey from England. There were signs of softening in her lung, and a few days later a cavern had formed. The case, to say the least, did not look promising. There was, however, one satisfactory sign—the absence of a high temperature of the body. Relying on this circumstance, I ventured upon expressing

a hope that, as soon as the patient was rested from her journey, a marked improvement in her health would take place. Shortly afterwards, in accordance with my advice, she took up her residence on the Ciniès hill, about three hundred feet above the sea. The case progressed most satisfactorily, the cavity remaining dry, and showing a tendency to contract. I saw this lady in the summer of 1873, at Geneva, in the enjoyment of fair health. Cases with softening or a cavity often do well on the Mediterranean coast on the sea-level, so long as they are free from febrile symptoms; but should a high temperature and quick pulse set in, together with a rapid loss of weight, then a change of residence must be insisted upon without any delay. This alteration for the worse is much more likely to occur at the seaside than at an elevation of a few hundred feet above the sea; and the probability is, that it will be less marked, if it does supervene, should the patient be residing at the time in some high locality. But if the experiment be made of moving down to the seaside while in this febrile condition with the object, perhaps, of seeking a more cheerful neighbourhood, it will be attended with very great risk, and even perhaps with danger to the patient.

I do not mean to state that phthisis is not fatal in winter in elevated regions near the Mediterranean coast; but it is certainly less so than close to the Mediterranean seaside. In the following case, life was certainly prolonged from a residence on the hills. A lady, aged forty, had been ill for six years. She was in a very low state of health when I first saw her at Nice, on December 4, 1872; her lungs exhibiting signs of consolidation, with cavities on both sides. I advised her to move up to Cimiès. There the pure light air of the hills revived the patient; she improved to some extent, and recovered her spirits naturally buoyant and cheerful. The winter proved much less trying to her than might have been anticipated; she went out for daily walks in the garden of the hotel without suffering any pain, and

hardly conscious that her life could not last much longer. After a time, a Bath chair had to be sent for; then she took to her bed, and in April sank peacefully. No doubt, in this case a residence on the hills preserved life throughout the winter, and succeeded in mitigating pain and mental distress to a considerable extent.

Thus it is that a pure air possessed of genial warmth, with a comparatively low barometrical pressure, is beneficial, as a rule, to all cases of phthisis with a high temperature and a quick pulse. Occasionally, these symptoms are arrested; in most instances, they are relieved; and, where a fatal termination cannot be averted, life is either prolonged, or, at all events, carried on under the most favourable circumstances.

Some consumptive patients, however, do well at the seaside. The main character of these cases is the absence of febrile symptoms; they enjoy a fair state of health, although with deficient breathing power. All the other functions are equally weakened, although normal in other respects, thereby re-establishing the balance of energy which should exist between them. I am inclined to believe that the most suitable resort for this class of cases is some warm sheltered spot on the Mediterranean coast. These invalids live a comfortable painless existence, taking a moderate amount of exercise on the level ground, but unequal to any real exertion.

To the question, are consumptive people, as a rule, better or worse on the Mediterranean coast at the end of the winter season than at the beginning? I would answer: They are sometimes better, and often much the same, but would probably have been worse had they wintered at home. In general, especially if a residence be carefully selected, consumptive patients undergo at first a marked improvement. The following case may be cited, amongst many others, as an illustration of the favourable change which occurs in health on arrival in the South. A young lady, with consolidation and softening in progress in one of her lungs, gained over one stone weight

in two months and a half after her arrival at Cannes. She weighed on November 9, 1874, 7 st. $1\frac{3}{4}$ lbs., and on January 23, 1875, 8 st. $4\frac{1}{2}$ lbs. It must be acknowledged that she was in a tolerably fair state of health on leaving home; still this increase in weight is truly remarkable. She returned to Cannes in November 1875 as well as when she left, the cavity in her right lung having much contracted, and there being no sign of softening, or, indeed, any other physical signs. She weighed 7 st. $13\frac{1}{4}$ lbs. on November 19, having only lost $4\frac{1}{4}$ lbs. since the previous month of April. At present, January 19, 1876, she looks perfectly well, although she is still troubled with cough and expectoration. An early improvement under proper management often meets with a check from some unaccountable cause in the middle of the season, or about the middle or end of January, when mild damp weather succeeds to a fine, clear, and bracing atmosphere. Consumptive patients sometimes then fall off in health rapidly, and it is very difficult to arrest this downward progress. The only plan I know of is to insist on an immediate change of residence, moving uphill to an altitude of a few hundred feet above the sea, if possible.

Here is the greatest difficulty we have to contend with. Not only is there a want of accommodation for invalids on the hills near the Mediterranean coast, but an objection, on the ground of such a residence being lonely and dull, has very often to be overcome. My usual answer is, that the pleasure derived from the consciousness that health is improving, will greatly outweigh any drawback consequent on a removal from a centre of social attraction.

With respect to the influence of a winter season near the Mediterranean upon the progress of laryngeal phthisis, I believe this affection in its most acute form is not often met with in the South. Several of my consumptive patients, however, have suffered from their larynx. This extension of the disease was usually attended with but little or no pain, although accompanied by more or less discomfort and aphonia. When the aphonia is complete, I question

whether the voice can be recovered; when only partial, the voice may improve under treatment. The climate which suits best in cases of laryngeal phthisis is also that most likely to benefit the pulmonary affection. The laryngeal disease, as I have seen it in the South, with one exception (a case of a poor man in straitened circumstances) had nothing of the virulence I often found it to exhibit in London amongst hospital patients. But then it must be remembered that those who can afford to resort in autumn to the mild climate of the Mediterranean coast, would also be likely to suffer least at home from laryngeal phthisis.

In my next chapter I shall allude to the subject of climate, and explain, by having recourse to physiological considerations, how it is that stations at some elevation above the sea are, as a rule, those which are most likely to benefit consumptive invalids.

CHAPTER II.

PHYSIOLOGICAL CONSIDERATIONS.

So far I have entered on the medical history of those consumptive patients who are usually sent to winter on the Mediterranean coast. I have also attempted to trace the influence of the southern climate on the progress of phthisis, insisting at the same time on the careful selection of the site for the residence in each individual case, especially with reference to elevation above the sea-level.

My present object is to enquire into the physiological influence of differences of atmospheric pressure upon the human body. It is now, I think, generally acknowledged that altitude is a very important consideration with respect to the residence best suited for consumptive

invalids. Of course, the Mediterranean coast does not afford means of treating phthisis at such great heights as St. Moritz or Davos, which are admirably suited for a summer sojourn; but it unites a certain elevation above the sea with a mild temperature well adapted for a winter resort.

Such a thing as a perfect climate is not to be met with anywhere; at all events, certainly not for human beings. With regard to the vegetable kingdom, some trees, such as the *Wellingtonia* in California, and the *Eucalyptus* in Australia, appear to be possessed of a wonderful longevity. On the Sierra Nevada in California, there are, as many of my readers are aware, *Wellingtonias* (*Sequoia gigantea*) considerably over a thousand years old, and bidding fair to live for another thousand years to come. With these wonders of Nature, the climate, I may say, is as nearly perfect as possible. In the autumn of 1873, having visited one of these remarkable groves (the Mariposa), I found, by walking round one of the trees and counting the number of steps, that its circumference measured approximately over one hundred feet, including of course the immense projecting roots. The tree called the Grizzly Giant, seven and a half feet above ground, has been ascertained to have a circumference of seventy-eight feet and a half; and another observer estimated its height at nearly three hundred feet. By counting the number of rings on the stump of one of the trees which had been cut down at a height of six feet, it was found to be thirteen hundred years old ('Tourist's Guide,' Yosemite). An idea of the size of the trees may be formed from the fact that in the hollow trunk of one of them I stood on horseback, side by side with three other riders; and I passed on horseback through the hollow trunk of another which was rotting on the ground. There are other smaller *Wellingtonias* in company with the giants; but they look so much their juniors, that they will have to outlive many centuries before they can aspire to be considered as *big trees*.

If I have alluded to the present subject, it is to observe that the climate in which these enormous Wellingtonias prosper must be wonderfully adapted to their longevity. Indeed, there appears no reason why they should die at all, except through the hand of man, who everywhere seizes upon Nature to turn her to his advantage. The enormous stores of heat, which probably thousands of years have accumulated on the Sierra Nevada, have already been made use of by the Indians, and many of the trunks of the big trees, left standing, have been hollowed out by the action of fire long before the white man knew of their existence. It is our business, in a medical point of view, to ascertain the cause of this extraordinary prolongation of vegetable life. First of all, it may be observed that all circumstances unite towards that object. The atmosphere of these mountains is pure and dry; I believe it is never foggy. The rainfall is inconsiderable; the summer is dry, and never very hot; while the winter is never very cold. There are hardly ever any thunderstorms, or, at all events, very few in those parts, as I was told by a person inhabiting Clarke's farm, the nearest habitation to the Mariposa grove. The approximate height of the Mariposa grove above the sea is, I believe, between five and six thousand feet. The spot is admirably sheltered from the winds by its position in the Sierra, so that hurricanes and gales of wind are scarcely known in these solitary regions. The soil must supply an inexhaustible amount of nourishment from the remains of thousands of trees which are being turned into food for the support of the giants. Animal life is nearly absent from these forests; there are very few, if any, bears in that neighbourhood, and apparently no woodpeckers or insects to destroy the bark and wood, which are said to be protected, moreover, from insects by the presence of a peculiar secretion; and there are, I believe, no squirrels to feed upon the fruit of these enormous coniferæ. These trees have been left to grow, fighting an easy battle of life, and feeding upon their weaker congeners, some of

them probably for several thousands of years. Their only enemy is the snow, which occasionally falls heavily in winter, and lops off the tops of the trees, or breaks off some of the higher branches.

Before entering upon the influence of altitude on the treatment of consumption, I must beg to allude shortly to the theory of the interchange of gases in respiration. In the 'Lancet' for February 2, 1867, I communicated a letter to the editor, explaining how Graham's discoveries on the absorption and separation of gases by colloid septa, appeared to me to afford the best means of accounting for the passage of carbonic acid out of the blood and lungs, and the admission of oxygen into the blood through the pulmonary tissue. The phenomenon was described as due to the solubility of carbonic acid and oxygen in the damp pulmonary tissue, and their subsequent movement by *physical diffusion*—the one out of the blood into the pulmonary alveoli, the other from the alveoli into the blood.

I observed in this communication that the evolution of carbonic acid at the lungs might be considered as regulated by four different conditions:—1. The amount of carbonic acid contained in the blood; 2. The degree of readiness with which the carbonic acid travels through the tissues of the lungs; 3. The temperature of the lungs; 4. The amount of air taken into the lungs at each respiration. I did not at that time allude to another circumstance which clearly has a very important bearing upon respiration; namely, *atmospheric pressure*. There are two physiological circumstances to be considered in connection with the influence of a reduction of atmospheric pressure upon respiration: 1. The fact that the oxygen in a given bulk of air is proportionally lessened; and 2. That the escape of carbonic acid from the lungs meets with less and less resistance in proportion with the fall in the height of the barometer. Dr. Lombard, in a paper entitled 'De l'Immunité Phthisique,' quotes a table of numbers calculated by Professor Marignac of Geneva, showing the pro-

portions of oxygen contained in the atmosphere (at 0° C.) at different degrees of altitude above the sea. According to this table, at a height of 2,000 mètres—rather less than that of Mexico—the oxygen in the air is reduced from 0·2988 centigrammes per litre of air at the seaside to 0·2324 centigrammes. At Mexico (2,227 mètres) an adult was found to consume twice as much oxygen and produce twice as much carbonic acid as in Paris (experiments of Andral and Gavat in Paris, and Léon Coindet in Mexico). Dr. Jourdanet,¹ after having practised for six years near the coast of the Gulf of Mexico, spent twenty years on the high plateau of Mexico, and there he observed that the appearance of the inhabitants contrasted in a remarkable way with that of the people living in the low country. The former, who resided in an atmosphere comparatively lighter and less rich in oxygen, had an anæmic appearance, and were decidedly possessed of less muscular power than the latter. On one occasion he observed the blood of an artery which had been severed during an operation to exhibit a deficiency of bright red colour. From these various circumstances he concludes that the phenomena of oxidation in the body at such a height are less active than at the seaside.

Dr. Bert² states, as a result of his experiments, that a falling off of pressure acts in the same way as a lessened quantity of oxygen (privation d'oxygène). His experiments were carried out in closed vessels, in which the animals experimented upon were placed; they were found to absorb less and less oxygen, and produce less and less carbonic acid, in a given time in proportion with the diminution of pressure, and he adds: 'It is more than probable that the succession of the phenomena occurs in the same direction in air undergoing renewal.'

¹ 'De l'Influence sur la Pression de l'Air sur la Vie de l'Homme,' 1875.

² 'Recherches expérimentales sur l'Influence que les Modifications dans la Pression barométrique exercent sur les Phénomènes de la Vie,' 1874, p. 80.

We know to what extent the pressure of the air checks the boiling of water; this it does by preventing the formation of steam, or escape of the water in the form of vapour; and just as a diminished pressure opposes less resistance to the boiling of water, so must it also assist the blood in getting rid of the carbonic acid it contains. A better illustration is the readiness with which soda-water, or water containing carbonic acid, parts with its gas when placed under an air-pump receiver afterwards exhausted of its air. When the lungs are thickened by disease and supplied with less blood than in health, the importance of such a means of favouring the elimination of carbonic acid at the lungs as diminished atmospheric pressure, must be very great. On removing from the seaside to the height of a few hundred feet, a sensation is experienced quite in keeping with the above remark. The air appears lighter, and a feeling of comfort is experienced attending the act of respiration which was unknown near the sea. Those who are asthmatic will perhaps be the first to notice the difference; but a similar relief will be experienced in all cases of consumption. Not only will respiration be carried on with greater facility at a certain height above the sea, but the cutaneous exhalation of carbonic acid will clearly be favoured by the same circumstance. Let anybody enclose his arm in an india-rubber bag partly full of air, as I have done, and, after an hour or even half an hour, draw two or three pints of this air through a solution of barium hydrate in water: a precipitate of barium carbonate will be obtained, more abundant than that which a similar bulk of pure air would have yielded in the same solution. It is, therefore, very obvious that the skin gives out carbonic acid; and it may be safely concluded that, in cases where the evolution of carbonic acid through the lungs is impeded, the skin takes upon itself the extra work, acting an important part as an organ of respiration. The reverse must also be true; and I have no doubt that circumstances checking the circulation at the surface of the body, such as a sudden

accession of cold, must, by calling upon the lungs to do extra work, often be the cause of pulmonary irritation attended with cough. Cutaneous respiration appears to be so important a function with certain animals, such as frogs, that they have been known to live for a considerable period after the removal of their lungs. 'Thus Paul Bert states that Albin (*Sulla Respirazione nelle Rane*) has seen frogs live for a period of a hundred and sixteen days after the excision of their pulmonary organs. ('Leçons sur la Physiologie comparée de la Respiration, 1870,' p. 276.) I cannot, therefore, insist sufficiently on the importance of attending to the free action of the skin both as a perspiring and breathing organ. Access of air to the surface of the body should be promoted by every means consistent with protection from cold. Woollen textures, such as flannel, will answer the purpose best. When patients come to me with chamois-leather jackets, perhaps worn over the skin, or leather chest warmers or protectors, I make it a point to advise their being at once given up.

That hæmoptysis is due, in many cases, to a state of malnutrition of pulmonary vessels is, I think, a conclusion at which we must necessarily arrive; and any amount of carbonic acid which may remain in excess in the blood or pent up in the lung-tissue, must assist in keeping up this morbid state; hence, the check hæmoptysis meets with, on rising above the sea-level, will depend upon an improvement in the nutrition of the lungs due to their parting the more readily with the carbonic acid they contain.

Some people live several hours daily under conditions of pressure which must interfere considerably with their respiration and other functions; I am alluding to professional divers. I had heard that divers, in consequence of their being subjected to sudden and considerable changes of pressure, occasionally bleed at the nose and ears on returning to the surface of the water; and, on meeting a friend last summer who had been engaged with diving operations, the conversation naturally turned upon that subject. What I gathered from this gentleman, at the

time, greatly excited my interest; and on reconsidering later the effects of the enormous pressure the body must sustain at a depth of about a hundred feet, I wrote to him, asking him if he could oblige me with a few additional particulars as to the influence of diving upon the body. In the kindest possible manner, he procured and sent me three letters, one from Mr. A. C., late Diving Inspector of Her Majesty's ship 'Excellent;' one from Mr. G. C., Diving Gunner of Her Majesty's ship 'Excellent;' and one from Mr. J. H., Diver, Her Majesty's Dockyard, Portsmouth. Thus it was impossible to be supplied with information from more trustworthy authorities.

Perhaps, the earliest unusual sensation felt on being lowered under the surface of the water is that of pain in the ears; this first effect of pressure is, indeed, well known to most of those who have gone down in the diving bell at the Polytechnic Institution. My friend writes, that he has found the act of swallowing his own saliva to afford a marked relief in such cases. He observes: 'Your ears, somewhere about the drums, give a little crack like cracking of the finger-joints, and you feel immediately relieved. The moment you touch the bottom, the pain in the ears, which is like having bradawls bored into them, and is sometimes very acute, ceases.' The late diving inspector of Her Majesty's ship 'Excellent' remarks: 'The only part of the body in which the rush of blood was felt painfully was the head, and that I believe arose from the gradual compression of the air in the dress as the diver lowered himself in the water. The sensation depends greatly on the manner of the man's descent; if he go slowly down, ascending at intervals a trifling distance, he greatly diminishes the pressure, and *vice versâ*.' Mr. G. C. has been fourteen years a diver, five and a half years of which he has passed in training divers for the navy. The first time he went under water, he felt a very severe pain in the ear, but no longer noticed it after a little time, until he became immersed in deep water, when it again returned to some slight extent, but disappeared on his

reaching the bottom in eighteen fathoms, or at a depth of 108 feet. He was then, he writes, 'quite comfortable.' Mr. J. H. has been diving for nearly thirty years. During the whole of that period, he has had almost daily practice, and has been down under water from one to four hours at a time, and at depths varying from five to eighteen fathoms. He remarks that the greatest pressure in descending to great depths is felt between the legs (crutch), where a sensation is perceived as if a knife were entering the body at that part. When troubled with a cold, the drums of his ears have been stopped, and, while descending, his head has experienced a sensation which he compares to its being pierced through. When suffering from slight rheumatism, he has felt as if his flesh were being torn to pieces.

Life can, therefore, be carried on with comparative comfort, when in health, for a period of from one to four hours, at a depth of about 108 feet, and work under such circumstances can be done, necessitating considerable muscular exercise, such as unloading a sunken ship. The return journey to the surface is, however, always apparently attended with more or less discomfort. Mr. J. H., with his experience of nearly thirty-one years, writes: 'On returning to the surface, blood invariably rushes to the head.' During the whole of his career, he had never bled at the nose or ears, but had seen instances of men coming to the surface bleeding from those parts, though from nowhere else. Mr. A. C. 'has never known of a diver bleeding from anywhere but the nose, mouth, or ears, and then only through fright or exhaustion.' Mr. G. C. has seen instances of men coming up bleeding at the nose and ears. He thinks that must be through weakness, for they were in shallow water, and only about one hour down. With respect to the influence of the state of health of divers on their sensations under water, some very interesting particulars are contained in Mr. A. C.'s letter. He observes: 'The general symptoms are, in my opinion, to be gathered from the man's own

state of health, or habits; if he is given to drink, then you may expect an accident, or sudden death, at any time; or, if he is consumptive, or his chest the least affected, the air is not sufficiently pure for him. During the latter part of my time as instructor in the "Excellent," I had been suffering from chest disease; and the last time I was down I could not remain five minutes, as the air was not pure enough for me to breathe.' Mr. G. C., when having a slight cold, felt hot flushes all over his body, and a pricking sensation. Now, if a column of thirty-three feet and ten inches of water exert a pressure of about 15 lbs. on the square inch, at a depth of 108 feet the pressure will be equal to about 47·9 lbs. on the square inch: a man of a height of 5 feet 8 inches, the surface of whose body would be equal to from 2,325 to 3,100 square inches, would therefore, at the depth of 108 feet, support a pressure of water of from 111,367 to 148,490 lbs. At the seaside, the atmospheric pressure on such a person would amount to from 34,875 to 46,500 lbs. He would, therefore, while at a depth of 108 feet, be subjected to a pressure of from 76,492 lbs. to 113,615 lbs. in addition to the weight he had to bear from the atmosphere at the seaside. On coming to the surface, this enormous excess of pressure is got rid of; no wonder a sensation should be felt of rushing of blood to the head, and that sometimes hæmorrhage should follow. The most remarkable feature of immersion in deep water is, perhaps, the fact that respiration can be carried on, apparently without difficulty, under such a pressure; and it is natural enough that, should the diver have anything the matter with his lungs, his respiration should be seriously interfered with. In such cases he becomes liable to be poisoned by his own carbonic acid, as the blood must find it very difficult under such a pressure, when the lungs are not in a perfect state of health, to emit the carbonic acid it contains; the air, if plentifully renewed, is not too impure for the diver to breathe, but his blood becomes impure from its retaining its own carbonic acid. The pheno-

menon is precisely the same as when increased pressure is brought to bear on boiling water; the boiling instantly stops, and steam ceases to be evolved.

Now, the difference of pressure of the atmosphere on the human body at the seaside and on the top of Mont Blanc amounts to about 15,432 lbs., being reduced by nearly one-half; and we can readily imagine the greater freedom with which carbonic acid will part from the blood in the lungs at such an elevation. It is really impossible to refrain from sharing Dr. Lombard's feeling of wonder that the body should be able to adapt itself to such extremes of external physical conditions.

CHAPTER III.

ON sitting down to write these few pages, it occurred to me that the course most likely to interest my readers was to begin by enquiring into the character of the cases of pulmonary affections sent to winter in the South, together with their usual progress under the favourable conditions met with on the Riviera. I next appealed to physiology for explanations of the influence of the winter climate of the Mediterranean coast upon health as shown by clinical observations. I now propose adding shortly to the subject of the last chapter, and then illustrating the influence of the climate of the South by relating in a very abstract form the result of my practice at Nice and Cannes, with reference to those of my patients who have wintered at a slight elevation above the sea.

I have stated, as may be remembered, that a class of consumptive invalids who spend the winter in the South, derive especial benefit from a residence in some high place at a little distance from the Mediterranean seaside, while with others the chronic stage is prolonged by a

sojourn in a sheltered and warm spot close to the sea. The main characters of those cases which do best at a certain elevation are, as a rule, a liability to febrile symptoms and a tendency to hæmoptysis; while patients, whose lives are clearly prolonged in a warm though depressing sea-climate, are usually those whose energy or *vis naturæ* has become exhausted. These latter lack the power of recuperation if placed in a bracing air; or, should this capability be left to some extent, as is usually the case, it soon wears out in a high and bracing locality, and the result is a state of debility; while a much better plan would have been to husband strength by selecting a residence in a climate which calls only for a small expenditure of natural or vital energy. A similar overstraining of vital powers is occasionally produced by the too long continued use of cold water. I have met with a young girl who delights in sea-bathing. In autumn, she bathes in the Atlantic, and in the winter time has a daily plunge in sea-water taken up to the villa near Nice where she resides. So long as she takes the baths, she is in a state of exuberant health; but, on stopping them, she soon becomes anæmic and weak. This was particularly marked during the winter 1873-74, when, after the baths had been continued for seven weeks, I recommended that they should be given up, fearing a reaction; which, indeed, came on just as I had anticipated. Where the advantages of a bracing treatment are so generally acknowledged as they are in England, we should be careful not to run into extremes. There is no reason, because a means of treating diseases is successful in many cases, that it should be carried out too far, and become productive of mischief on that account.

We cannot but wonder at the amount of useful labour that can often be performed by a certain class of consumptive invalids under climatic circumstances essentially relaxing or even depressing; they have only to submit to certain rules, which after a time constitute a mode of living

pleasant in many respects. There is a very interesting physiological experiment of Claude Bernard which bears most distinctly on the present subject ('Substances Toxiques,' p. 131). A sparrow was placed in a bell-jar, of a capacity of about two *litres* (three pints and a half), full of common air. After a lapse of three hours, the bird was dying; but, on being withdrawn from the jar and warmed, it took to flight. The air in the receiver then contained 3·5 per cent. of oxygen, and 17·5 per cent. of carbonic acid. After the bird had remained in the jar for two hours, being still very lively, a second and a third sparrow were placed in the same receiver, and both these birds died nearly instantly. When the first bird, which had been taken out of the receiver still alive, had recovered its entire vitality, it was put afresh into the jar, where it died immediately. In this experiment, the first sparrow experimented upon had become diseased, in consequence of its having converted the oxygen of the air it had to breathe into carbonic acid. There followed a depressed state of all its functions, and a species of equilibrium became established between the degree of vitality of the animal and the condition of the atmosphere in which it was placed. Bernard observes: 'In an infinite number of cases, you will meet with instances of resistance from animals weakened or ill. The explanation of the circumstance that a person can live in a room where a man in good health would die, is the fact that the body has a tendency to adapt itself to the medium which surrounds it, and requires less and less oxygen in proportion with increasing debility.' In another experiment reported by Claude Bernard, and performed by Messrs. Regnault and Reiset, a marmot in a state of hibernation was placed in a receiver containing air enough to keep up its respiration for twenty-four hours. It woke up during the experiment, and died after consuming the amount of oxygen destined to keep it alive for a longer period, had it continued to hibernate. On that same occasion, another hibernating

marmot, which happened to have been placed in the receiver together with the one which awoke and died, continued to live in the hibernating state.

We thus account for the fact that consumptive invalids sometimes do well under circumstances which may prove debilitating to healthy persons, while these same patients would become worse in a bracing air; or, if slightly benefited at the time, would feel less well, and exhausted, on returning to the relaxing climate of the seaside, which they ought not to have left. A striking case of the kind occurred to me this last winter. A gentleman, twenty-eight years of age, who had been consumptive for many years, with a tendency to hæmoptysis, whose body was greatly emaciated, and in ill health in other respects, took up his residence in an hotel near the sea, situated in what I should call the non-bracing climate of Cannes. He called upon me shortly afterwards; and, fearing a return of hæmoptysis, I advised him to remove from that hotel into another away from the sea, on the high ground, where he would breathe a pure bracing air. He adopted my suggestion, but unfortunately failed to benefit by the change. He very soon began to sleep less well than he did at the seaside, and then became restless, uncomfortable, miserable both mentally and physically, regretting he had left the hotel where he first resided. This gentleman soon afterwards gave up Cannes altogether.

The object sought by the treatment of consumption in the South is, of course, first of all a cure, if possible; but, short of this desired result, very great benefit and a considerable extension of life may be attained by acclimatisation to the Mediterranean seaside in the winter season. Thus at Cannes, Nice, and Mentone, and I have no doubt also at Hyères, Algiers, and other places similarly situated, patients with cavities in their lungs return every winter, feeling occasionally better, and often in the same state of health, or but little if at all worse. On enquiring into the cases of all kinds I have treated both on the hills near Nice and also on the high ground at the

back of Cannes,¹ I find them to amount to fifty-seven in number. Of these, eleven patients recovered their health entirely, thirty-eight improved, six became worse (all cases of consumption), and two died; of the latter, one died of consumption, the other of diphtheria contracted on the spot. The number of cases of phthisis under my care on these stations amounted to nineteen, of which only one died during that period. This patient was a lady in a very weak state when she arrived at Nice, exhibiting the physical signs of cavities in both lungs, and symptoms of active disease in other respects. Her case has been already noticed. She sank early in the spring. Of the eighteen cases left, eight are known to me to have died subsequently to their leaving the hills. On the other hand, I could bring forward several cases of phthisis attended with very great improvement after a succession of winters spent in the South. It is difficult, however, in some of these successful instances, to be quite certain that the disease was originally of a tubercular or pneumonic nature. A gentleman, aged 24, called on me on June 25, 1869. Since the end of the preceding month of November he had been troubled with a dry cough, and had had one attack of hæmoptysis; he was anæmic, and looked thin. Physical signs: right apparent falling in at apex; some degree of dulness on percussing clavicle; decided humid crepitus and loud vocal resonance at that apex. No other pulmonary change. A brother had died of consumption. In October 1869, he weighed 8 st. 10 $\frac{3}{4}$ lbs. On January 16, 1875, or six years later, this gentleman was residing at Cannes, when I saw him. He was then enjoying remarkably good health, walking six hours without over-fatigue. Physical signs: respiratory murmur harsh at right apex, with vocal resonance, and rather less loud there than at the corresponding spot on the left side. No record as to the percussion-note; to the best of my recol-

¹ This statement refers to the cases treated previous to the original publication of the present papers in the 'British Medical Journal.'

lection, it was entirely free from dulness. He then weighed 9 st. $2\frac{3}{4}$ lbs. This gentleman has spent every winter in the South, principally at Cannes, since 1869. I have also had under my care a lady who lives in winter on the Cimiès hills near Nice; she exhibits the physical signs of chronic congestion of the base of the left lung, with malnutrition of the pulmonary organ (as evinced by occasional attacks of hæmoptysis). Although not very strong, she goes about and acts much like a person in good health. After three winters, during which time I examined the state of her lungs occasionally, there was little or no material change in the physical signs of her chest.

Of course, among the total number of cases referred to above, there were a few patients who had been taken ill during their residence in the South, where they had not come for the sake of their health. Besides consumption, I had to attend cases of quinsy, chronic irritation of the pharynx and larynx, failure of the action of the vocal cords, bronchitis, hæmoptysis, pneumonia (one case), asthma, cerebral debility from overwork, hysteria, general debility, erysipelas (two cases, one very severe), rheumatism, simple continued fever (one case), measles (two cases), psoriasis (one case).

The most striking beneficial influence I have met with of the change from the seaside to the hills, was observed in the following instances: one case of pneumonia; one case of uncontrollable hæmoptysis without any positive pulmonary disease; one case of simple continued fever; one of chronic bronchitis; one of phthisis. The first two cases were very remarkable, the acute symptoms subsiding immediately in the first, and shortly afterwards in the second. The hæmoptysis, which nothing could arrest, and had been productive of great debility while the patient was at Nice, ceased three days after her removal to Cimiès (spring of 1873); and nine days later she was well enough to leave for Ireland. I heard in winter 1874-75 from Dublin that she was doing well. The case of simple continued fever was that of a young girl aged 13, with a

slender and tall figure and a flushed face (weight of body 6 st. 13½ lbs). I first saw her at Nice on January 25, 1873, when her pulse beat 164 times per minute, and her temperature under the tongue was 101·7°. She had but an indifferent appetite. There was nothing the matter with the lungs or any other organs, and she had menstruated regularly during the previous six months. Her mother informed me that for years she had been subject to similar attacks. She was very fond of sitting in the sun, either in her room or out of doors, and seldom used a parasol. I treated the case with quinine and tincture of digitalis. On January 31, temperature 103·5°; pulse 146. On February 4, she left Nice for rooms in an hotel on the Cimiès hill, and the next day I already found her better. On the 7th, she was much better; her appetite was returning; temperature 101·4°; pulse 126; an attack of erythema nodosum on both legs. February 11, appetite very good; temperature under the tongue, after an exposure of six minutes, 98·6°; pulse 98, strong and regular. She was looking much better; was taking cod-liver oil, besides the quinine and digitalis. On February 19, the pulse rose to 120 per minute; temperature 99°. She looked and felt, however, much better, having recovered her strength and appetite. Weight of body, 7 st. 2½ lbs., being a gain of three pounds in about fourteen days. She then left for Florence. The case of chronic bronchitis to which I have referred was accompanied with a very distressing cough and much prostration. I attended this lady at Nice from the 2nd to the 28th of February, 1872, when, as the treatment appeared to be of no avail, she moved up to Cimiès, in accordance with my advice. She gained strength and health very rapidly in her new residence, but was still suffering from paroxysms of cough when she left for Switzerland on the 9th of April following. The case of phthisis has been already alluded to, and is one which may be taken as a type of a number of other similar instances of caverns in the lungs without any

febrile symptoms; the lady improved greatly after a residence at Cimiès.

Some people object to the hills near the Mediterranean on the ground that they are colder and less well sheltered from the winds than the seaside. It is true that on the chain of the Maritime Alps, about forty miles from the Riviera, the weather must be very severe in winter; and even at such a place as Grasse, one thousand feet above the sea, and at rather less than an hour from Cannes by rail, the winds must be very cold and trying in the winter months. Such is not the case, however, on the hills and high ground in the immediate neighbourhood of the Mediterranean coast. I have explored those hills, and observed a number of spots sheltered in a great measure from the easterly and north-westerly winds, and well adapted for a winter residence.

While wintering at Nice, I placed, on January 5, 1873, a minimum thermometer (by Casella) in a small cairn on the northern side of a pile of stones erected on the summit of Mont Pacanaglia, a hill rising to a height of 1,890 feet above the bay of Villefranche. The cairn was not fully open, but air reached the instrument freely through a few loose stones which were placed at its entrance in order to conceal the thermometer. I examined the instrument on March 25 following, when it registered 0.7° C. (30.8° F.). During that same lapse of time, the lowest reading of a minimum thermometer at Nice, the instrument being hung up against a shutter on the north side of a house, was 0.5° C. (32.8° F.) on February 13 and 14. It therefore appears that at 1,890 feet high, on a spot nearly towering over the Mediterranean, the temperature had been but very little colder than at the seaside. One observation, however, is not enough to settle the question. I should consider the radiation of heat to be decidedly greater at that height than at the sea-level, as I remember seeing ice one afternoon, about a quarter or a third of an inch in thickness, in a small pool sheltered from the sun on the slopes of the mountain, while what little ice had formed

at Nice during the night had disappeared long before noon. It may be added, that on two or three occasions in winter I have observed snow to fall on the summit of Mont Pacanaglia, but do not recollect seeing it at a lower level than two or three hundred feet from the highest point, and after a very few hours it melted away entirely. I have also made a few comparative observations as to the temperature at the top of the Cimiès hill and in the town of Nice below. The minimum thermometer at Cimiès (300 feet above the sea) was placed against the trunk of a tree, and was consequently exposed to radiation in a greater degree than the minimum at Nice which was hung up against a shutter.

		Cimiès (300 feet high)		Nice (sea-level)
February 19	.	34·9° Fahr.	.	40·1° Fahr.
" 20	.	35·6°	" .	37·4° "
" 22	.	38·3°	" .	40·1° "
" 23	.	37·4°	" .	40·1° "
" 27	.	27·4°	" .	42·8° "
March 3	.	38·3°	" .	40·1° "
" 4	.	34·9°	" .	39·2° "

If we allow a correction of about 3° F. for the difference in the exposure, the readings of the two instruments will not differ much.

I do not wish it to be understood that the climate of the hills is not at all colder than that of the seaside; but it should only be considered as a trifle colder, which is certainly not sufficient to detract from the advantage of the light, fresh, and invigorating air of these charming resorts. Their great drawback is the want of accommodation. At Cimiès there are two hotels, or one hotel and one pension, or boarding-house. These, however, can only afford room for a limited number of invalids.¹ At Cannes there are most admirable sites, between one hundred and five or six hundred feet high, for large hotels or villas, where shelter from the winds, a southern aspect with exquisite views, and a pure bracing air, could be enjoyed. The hills are skirted with beautiful woods,

¹ Since the publication of the present remark in the 'British Medical Journal,' the size of one of the hotels has been considerably increased.

through which delightful walks might be made. Moreover, a canal, with a full supply of pure water destined to the use of the town, makes its way along the slope near the top of the hill, and would, perhaps, afford means of erecting a bathing establishment. It is true that there is still a want of carriage-roads, by means of which the various parts of the hills can be reached; but one excellent road has already been made, and others will undoubtedly be opened later.

I have attempted in these few chapters to establish rules, founded on physiological data, calculated to act as a guide when medical advice has to be given with reference to the advisability of wintering on the Mediterranean coast. These may be summarised in a few words as follows:—

1. The state of the vital power left in the patient is to be carefully ascertained.

a. If the vital power, although at a low standard, does not appear to be declining, and if the case be decidedly chronic, benefit may be expected from a winter's residence near the Mediterranean coast, on the sea-level, in a warm sheltered spot.

b. If the vital power be declining rapidly, although perhaps the affection may not be of long standing, it is questionable whether the South will arrest this downward progress. The air of the hills near the Mediterranean may check the evil for a time—say, perhaps, for half or two-thirds of the winter season; but the disease is not unlikely after that period to resume its ascendancy.

c. If the vital power should keep up well, although the disease be attended with a quick pulse and high temperature, together with progressing pulmonary mischief, a decided benefit is to be expected to result from one or more winter seasons spent on the Mediterranean coast; the hilly country, or high ground near the sea, being selected for the first period of the residence in the South.

2. The condition of the lungs of the patient, as determined by the physical signs of the chest, should be taken into consideration.

a. Patients with consolidation at one apex, although unattended with apparent ill-health, do well to winter in the South as a means of precaution; but such persons should be very careful to regulate strictly their mode of living abroad.

b. Patients with a tendency to hæmorrhage, and exhibiting little more than harsh respiratory murmur and debility, usually progress favourably on the hills near the Mediterranean coast. They should be careful not to take up their residence near the sea or at the sea-level, and to leave the South early in the spring before the warm weather sets in.

c. Patients with softening and cavities sometimes derive much benefit from wintering in the South. The state of their vital powers should be considered as a guide towards a decision being taken with respect to autumnal movements.

3. Patients should make up their minds beforehand, in accordance with medical advice, as to whether their case is likely to do best on the hills and high ground, or near the Mediterranean seaside; as, when they have selected their residence and settled down for the winter, they find it often very difficult and inconvenient to make a fresh move.

CHAPTER IV.

METEOROLOGICAL OBSERVATIONS MADE AT CANNES FROM
NOVEMBER 1, 1874, TO APRIL 30, 1875.

THE main object of these observations was to obtain data as correct as I possibly could, in order to compare the climate of Cannes with that of London or its neighbourhood during the same period. While spending two winters at Nice I kept a daily record of meteorological observations, thus becoming accustomed to the work of reading instruments regularly and correctly. My observations at Cannes, extending over the whole of the six months from November to April last, were made twice a day regularly, in the morning at nine o'clock, and at night between eleven and twelve o'clock. It will be observed, however, that for a fortnight in April the readings of the maximum thermometer are not recorded; this is owing to the circumstance that the sun, in its progress northwards, had in April overreached the angle of the wall of the house running east and west near which the instruments were placed. The setting sun, therefore, had shed its last rays on the maximum thermometer for some days before I detected the circumstance, the readings being consequently too high.¹

The instruments were all made by Casella, of Holborn, London, and consisted of a barometer, a maximum, minimum, a dry- and wet-bulb thermometer, and a thermo-

¹ In other respects the only observations wanting are: one minimum in December, two wet bulbs in February and one in April, and one dry bulb in February. In January, on three different nights, my only minimum thermometer being exposed to the air on the grass, I entered the estimated minimum temperature in the frame, which could be done with a degree of correctness sufficient to keep up the mean results.

meter with a protected bulb, used for taking the temperature of the sea.¹

The maximum and minimum thermometers were placed in a deal frame or open case, with no front or back to it, so that the air could move freely over the instruments, east and west. The two thermometers were hooked horizontally to two upright rods fixed to the upper side and floor of the box. The instruments were thus sheltered from the effects of radiation. Mr. Casella had disposed the dry- and wet-bulb thermometers in a perforated mahogany box, and this was hung up against the side of the frame in which the maximum and minimum had been placed. I have also observed the daily working of a hair-hygrometer, made with much care at the Manufacture of Philosophical Instruments of Geneva, but shall not record its reading on the present occasion, relying on those of the dry- and wet-bulb thermometers as tests of the relative degree of atmospheric humidity. The frame containing the instruments was made fast to the railing of a balcony on a first floor on the north side of the house. It was far enough from the glazed door opening on that balcony to eliminate any marked influence from the temperature inside the house. A wall on the east side of the balcony kept off the east wind, while access of air was tolerably free from the north and west. The instruments are graduated with the Centigrade scale, and I subsequently transformed the readings into Fahrenheit divisions with the assistance of Dowling's Tables. The relative degree of moisture was calculated from the readings of the dry- and wet-bulb thermometers, according to Glaisher's Hygrometrical Tables.

The temperature of the sea-water was taken in a large pitcher lowered into the sea from rocks situated near my house. On a few occasions, when the water was very

¹ In order to limit this report to the observations more directly of medical interest, I have left aside the readings of the barometer, although they have been carefully recorded in my note-book twice a day. They may turn out useful on another occasion.

rough, I had to take the temperature near the head of the pier, on its sheltered side; but this was avoided as much as possible, the results being a trifle different from those obtained along the shore.

Others besides myself were engaged last winter at Cannes with observations on the weather. Those recorded by Dr. de Valcourt were published in a local paper; and communications have appeared in the 'Times,' signed 'F. M. S.,' on a series of meteorological observations made last winter at Cannes.

My object is especially medical; hence my endeavour to compare as much as possible the results of my observations at Cannes with those obtained from similar observations in or near London.

Although want of time will prevent me from entering as much as I would have wished into the details of the subject, still I hope to be able to point out the main difference between the climate of the two places during the six months of the last winter season in the South.

The Weather.

The following table shows at a glance the state of the weather at Cannes last winter. The number of rainy days at Kew have been entered in a column adjoining that of the rainy days at Cannes for sake of comparison. I regret I had not a rain-gauge, and must limit myself to a statement of the number of days on which rain fell.

	Fine days	Overcast days	Rainy days	
				At Kew
November	20	2	8	12
December	18	0	13	15
January	23	5	3	19
February	15	4	9	12
March	21	3	7	8
April	20	1	9	10
Total	117	15	49	76

The weather at Cannes, and generally in the south of

France, was not so fine last winter as the year before ; still, with the exception of December when the number of rainy days amounts to 13, the season may be considered as including a fair number of fine days. While the total number of days from November 1 till April 30, on which rain fell at Kew amounted to 76, or 42 on 100 ; at Cannes, during the same period, they numbered 49, or only 27 rainy days on 100 ; of these 49 days 13 belong to December, while there were only 3 rainy days in January. If we take together December and January, the mean number of rainy days of the two months will amount to 8 for each month, which is nearly the mean number of rainy days for each of the other months considered separately.

Therefore, with the exception of December and January, the number of rainy days at Cannes was distributed pretty equally throughout the six months. The movement of the air was recorded on 46 of the rainy days, or nearly the whole of their number. The weather was calm twenty-four times. On eleven occasions northerly winds blew ; north and north-east nine times, north-west twice, and southerly winds five times. Rain therefore fell very nearly as often when the air was still as when it was in motion. In other respects, north-easterly winds prevailed over southerly winds in wet weather. The north-west wind, which is, as a rule, a particularly dry wind, was only attended twice with rain.

There were but very few overcast days, or days mainly overcast, at Cannes, as they amounted only to 15 in the six months. The reason of this is the fact that, when the sky is covered with clouds, the weather soon turns either fine or rainy ; an overcast state of the sky, while of common occurrence in England, is, on the whole, not often met with near the Mediterranean coast of the south of France. Usually, on waking up in the morning, the sun is observed to stream through the shutters ; at eight or nine o'clock a few fleecy clouds may be seen along the horizon, and there is a light breeze, or no wind at all.

Later in the day, or about noon, a breeze begins to blow, and should a few clouds gather in the sky, before dark they have blown away. At night a clear dark sky displays a particularly brilliant map of stars, amongst which our old friend, the Polar star, appears decidedly nearer the horizon than it does in England.

It is remarkable that a bright star-light night, which is often, as I have frequently observed in the north, the sign of rain, appears to have no such meaning in the south of France. The same brightness of the stars is often visible on high mountains; this I witnessed in a remarkable degree last summer while spending eight days engaged with physiological observations at the Col de St. Theodule, near Zermatt, at an altitude of 10,899 feet (Murray). This phenomenon is due either to a pure state of the atmosphere or to the humidity of the air. According to the late distinguished philosopher, Professor De la Rive, moisture, by imparting transparence to the particles suspended in the atmosphere, allows of a clearer and brighter vision of objects at a distance; and, on the other hand, it stands to reason that the fewer the solid particles air holds in suspension, the brighter the heavenly bodies will appear.

The proportion of fine days in the last winter months at Cannes was certainly high compared with the number of fine days usually enjoyed during the same period across the Channel. There were 117 fine days at Cannes out of the total number of 181 days, or 64 days on 100. During a portion of these 117 days invalids could go out and breathe the fresh air; and the benefit derived from the weather on no less than 23 fine days in January may be called invaluable to a class of people whose health makes fresh air a necessity, and who would hardly have been able to go out at all had they remained at home.

State of the Atmosphere (Winds).

	Calm	Light to fresh wind	Strong wind and gales
	days	days	days
November	19	6	4
December	14	10	7
January	20	5	6
February	15	9	4
March	4	22	5 (no gales)
April	3	15	12
Total	75	67	38

There is usually a great dread of the wind on the Mediterranean coast, and March and April have an evil reputation on that account.

There was, however, last winter a very great preponderance of days either calm or with a light breeze; the number of calm days amounting to 75, or 41 on 100, and a breeze from light to fresh blowing on 69 days, or 37 on 100.¹

There was a strong wind or gale on 38 days, and of that number no less than 12 days, or one-third, belong to April. Setting aside that month, the remainder of the windy days are tolerably equally distributed throughout the other five months. There were three gales in November and four in December; while in the proverbially windy month of March not a single gale was recorded. During that month the wind blew high on 5 days only. On the other hand, March was the month for winds from light to fresh, which were felt on 22 days, while the number of corresponding days was fewer in April (15). The order of the six months, with respect to their prevalence of winds, beginning by those months with the fewest windy days, was as follows:—

¹ There is a difficulty in estimating correctly the number of calm days. It is seldom that the air is quite calm during twenty-four hours in succession. By *calm* is meant 'mostly calm.'

WIND LIGHT TO FRESH

January
November
February
December
April
March

WIND STRONG TO A GALE

February
November
March
January
December
April

The calmest month was that of January, which exhibits 20 calm days and 5 days with a breeze from light to fresh.

A fine calm day at Cannes means a beautiful smooth sea, a soft and balmy, though rather bracing atmosphere, and a bright warm sun. One feels an instinctive desire for a walk along the seaside, where Nature can be seen most to her advantage. Conspicuous towards the east are the low shores of the green island of Ste. Marguerite; and on the west the mountainous coast of the Esterel shows its clear rugged outlines, with the dark blue sky on the background. Nearer, within perhaps a few yards, the gentle ripple rolls lazily on the stony beach. One of the great beauties of the Mediterranean Sea and its shores on a calm day is their perfect freedom from monotony. The eye ranges on ever-changing pictures; the appearance of the sea and land in the evening or afternoon is different from what it was in the morning; and even a painter will, I am sure, find a difficulty in obtaining colours which will allow him time to fix them on his canvas.

Mistral.—The mistral is a north-west wind,¹ varying from strong to a gale, always attended with a fall of the barometer, and, as a rule, very dry.

November 17, 1874, was attended with a gale from the north-west, beginning in the morning, reaching its climax at one o'clock, and subsiding in the evening. On that day the degree of relative humidity at nine A.M. was 58° (the range being from 1 to 100); it rose in the following night at 11.45 to 73.5°. The day before the wind began blowing, the air being calm, the atmospheric moisture was 63°. On

¹ There are occasionally gales from the west and south-west exhibiting the same extreme dryness as the north-west mistral.

November 19 another gale blew, apparently from the south-west, commencing at five o'clock in the evening, and lasting till ten o'clock next evening. The relative humidity remained low since the previous gale, but reached a still lower degree on the 20th, when it amounted to 52° at nine A.M. On January 16 in the evening a strong north-westerly gale began after a rainy day. The next morning at nine o'clock the moisture had fallen to 48.8° . The gale shifted to the south-west, abating at about two P.M.; but it rose again, when it blew furiously, the same evening. At 11.30 that night the relative humidity was 45.2° . The next day my note of the weather was 'beautiful morning, calm;' the relative humidity at nine A.M. had then increased to 69.5° , and the following night was 87.4° . Three days later, on the 21st, another gale rose in the forenoon; at nine A.M. on that day a light northerly breeze was blowing, and the relative humidity, which the night before was 87.7° , registered at that hour (nine A.M. on the 21st) 82.2° ; at four P.M. the moisture had fallen to 53.8° . The gale lasted till five P.M. On the 22nd the degree of moisture was at nine A.M. 66.4° , and that night 48.8° . The gale had then ceased, and the air was calm; rain fell on the evening of the 24th, till which day the degree of humidity had remained low.

The weather resumed its dryness immediately afterwards, the mistral returning on the 25th in the morning. This last gale blew more or less till 4.15 on the 26th, during which the readings for moisture were as follows:—

25th, 9 A.M.	.	.	.	58.3°
25th, midnight.	.	.	.	51.2°
26th, 9 A.M.	.	.	.	72.0°
And at night	.	.	.	62°

The hygrometrical state of the atmosphere remained low till the end of the month, although the air was calm.

April 7 was fine and calm in the morning. In the afternoon rain fell for about half an hour; a strong gale set in from the north-west about seven o'clock in the

evening, and blew all night, subsiding next morning. It then rose again, and lasted throughout most of that day. At nine A.M. on the 7th the relative moisture was 87° , and in the night of the same day, at 11.20, it had fallen during the gale to 62.8° . The record from the wet-bulb thermometers was accidentally omitted on the morning of the 8th, but the following night the degree of moisture registered 76.4° . By that time the gale was nearly over, and at nine next morning it had quite ceased; moisture then 60.2° .

Temperature of the Air.

The temperature of the air in the daytime and in the shade.
—Two sets of observations were recorded; one applying to the temperature of the atmosphere at nine A.M., the other to the maximum temperature in the twenty-four hours.

There is not a very great difference between the mean temperature of each of the six winter months at nine A.M., the highest being 56.7° in April, and the lowest 44.2° in February, while the mean temperature for the season at that hour is 50.1° . The six months written out in succession, commencing with the coldest, would follow each other thus:—

February
December
January
March
November
April

I have no record of the temperature at Cannes in October, but can say from personal experience that it is, as a rule, warm and oppressive, especially early in the month.

Turning our attention to a valuable meteorological paper by Mr. R. Strachan, F.M.S., which Mr. Scott, of the Meteorological Office in London, kindly placed in my hands, we are able to compare the mean temperature at nine A.M. of each of the six winter months at Cannes with the mean temperature in London at the same hour

(or nearly the same hour, on account of the difference of longitude) of the corresponding months in thirteen years, viz. from 1861 to 1873. These temperatures, taken in such a metropolis as London, where coal-fires may be counted by tens of thousands, must, of course, be rather higher than they would have been in the country. I subjoin them in a tabular form, together with the mean monthly temperatures at nine A.M. of last winter at Cannes. In this southern station, consisting of a small town and straggling villas, fires may be expected to impart to the atmosphere scarcely any heat, although there must be a certain absorption of heat by the houses on sunny days, checking the cold at night to a slight degree.

TEMPERATURE OF THE AIR AT CANNES AND IN LONDON
(MEAN FOR 13 SEASONS).

	At Cannes	In London at 9 A.M.	Increase at Cannes
For 13 months of February	44.2°	40.6°	3.6°
„ „ December	45.2°	40.9°	4.3°
„ „ January	49.6°	38.5°	11.1°
„ „ March	51.0°	41.0°	10.0°
„ „ November	54.0°	42.5°	11.5°
„ „ April	56.7°	47.7°	9.0°
Mean	50.1°	41.8°	8.3° mean increase

The temperature at nine A.M. cannot be considered as representing the mean daily temperature; had I also recorded the temperatures at nine P.M. the two together would have been much better adapted to that object. The mean temperature, calculated from that recorded at nine A.M. and between eleven and twelve o'clock at night, which is 49.0°, would approach nearer the true daily mean than that observed at nine A.M. Now this very temperature, 49.0°, is nearly that of the mean winter temperature given by Dr. Ch. T. Williams for Cannes, which he estimates at 48° F.¹ Comparing the temperature at nine A.M. at Cannes with that observed in the morning of the same day at Kew, we have a result interesting to record, although there be a slight difference of time between the

¹ 'The Climate of the South of France,' p. 48.

two places. According to the report of the observations made at Kew, as published in the 'Illustrated London News,' ten o'clock is the hour at which they were noted, and twenty-eight minutes are to be added for difference of longitude; so that there is an interval of very nearly an hour and a half between the readings of the instruments at the two stations. Notwithstanding this circumstance, it will be found that the temperature at Cannes was constantly higher than that observed on the same day an hour and a half later at Kew; and in December, which was a particularly cold month in England, there was a mean difference of no less than $14\cdot4^{\circ}$ in favour of Cannes. It is interesting also to notice that the temperatures at the southern and northern stations do not vary from one month to the other in the same order respectively, as will be shown by the following table, in which the months are entered beginning with the coldest:—

TEMPERATURE AT CANNES AT 9 A.M. (LOCAL TIME)		TEMPERATURE AT KEW AT 10 A.M. (LOCAL TIME)		DIFFERENCE IN FAVOUR OF CANNES	
February	$44\cdot2^{\circ}$	December	$33\cdot8^{\circ}$	February	$9\cdot2^{\circ}$
December	$45\cdot2^{\circ}$	February	$35\cdot0^{\circ}$	December	$14\cdot4^{\circ}$
January	$49\cdot6^{\circ}$	March	$41\cdot1^{\circ}$	January	$5\cdot6^{\circ}$
March	$51\cdot0^{\circ}$	November	$42\cdot2^{\circ}$	March	$10\cdot1^{\circ}$
November	$54\cdot0^{\circ}$	January	$44\cdot0^{\circ}$	November	$11\cdot8^{\circ}$
April	$56\cdot7^{\circ}$	April	$48\cdot2^{\circ}$	April	$8\cdot5^{\circ}$
Mean	$50\cdot1^{\circ}$	Mean	$40\cdot7^{\circ}$	Mean	$9\cdot9^{\circ}$

Hence the month of January at Kew—the warmest but one—and of February at Cannes—the coldest of all at that place throughout the winter—exhibit the same mean temperature in the morning, while January at Cannes resembles April in London.

Maxima.—The mean monthly maximum temperature extends from $51\cdot8^{\circ}$ to $61\cdot5^{\circ}$, while the mean for the six months is 57° . The six months at Cannes for 1874–75, and the corresponding months in London (mean of thirteen seasons), beginning with those with the highest maxima, would follow each other as in the subjoined order:—

MEAN MAXIMA AT CANNES (1874-75)		MEAN MAXIMA IN LONDON (FOR 13 SEASONS)		EXCESS AT CANNES	
April	61·5°	April	57·2°	April	4·3°
November	61·2°	November	48·4°	November	12·8°
March	57·6°	March	47·9°	March	9·7°
January	56·7°	February	45·7°	January	13·8°
December	53·4°	December	45·4°	December	8·5°
February	51·8°	January	42·9°	February	6·1°
Mean	57·0°	Mean	47·9°	Mean	9·2°

The maxima in April at Cannes are deficient, it must be recollected, by the omission of the first fortnight's observations, and it is hardly fair to enter that month in the table; still, bearing this in mind, the mean maxima in April are shown to be higher than they are in London by about 4·3°.

The mean difference for the whole winter season between the maxima at Cannes and in London amounts to 9·2°.

Having compared the mean maxima at Cannes for 1874-75 with the mean maxima of thirteen seasons in London, let us now enquire into the comparative maximum temperature at Cannes and Kew for last winter. The six months may be written out in succession in the following order, beginning with those exhibiting the highest mean maxima :—

1874-75.

MEAN MAXIMA AT CANNES		MEAN MAXIMA AT KEW		EXCESS AT CANNES	
April	61·5°	April	56·0°	April	5·5°
November	61·2°	January	48·3°	November	13·4°
March	57·6°	November	47·8°	March	10·6°
January	56·7°	March	47·0°	January	8·4°
December	53·4°	February	40·1°	December	15·6°
February	51·8°	December	37·8°	February	11·7°
Mean	57·0°	Mean	46·2°	Mean	10·3°

April is the month with the highest mean temperature both at Cannes and at Kew; between November at

Cannes, which is the next in order, and November at Kew there are no less than $13\cdot4^{\circ}$ difference in favour of Cannes. In December the excess is also high, amounting to $15\cdot6^{\circ}$; the mean difference between the two places is $10\cdot8^{\circ}$.

A comparison between the monthly *highest* maxima at Cannes and Kew will be best established by referring to the following table, in which the months succeed each other, beginning with those which exhibit the highest readings of the maximum thermometer:—

HIGHEST MONTHLY MAXIMUM AT CANNES		HIGHEST MONTHLY MAXIMUM AT KEW		EXCESS AT CANNES	
November	$69\cdot0^{\circ}$	April	$56\cdot0^{\circ}$	November	$21\cdot2^{\circ}$
April	$68\cdot0^{\circ}$	January	$48\cdot0^{\circ}$	April	$12\cdot0^{\circ}$
January	$67\cdot2^{\circ}$	November	$47\cdot8^{\circ}$	January	$19\cdot2^{\circ}$
February	$64\cdot4^{\circ}$	March	$47\cdot0^{\circ}$	February	$24\cdot3^{\circ}$
March	$64\cdot4^{\circ}$	February	$40\cdot1^{\circ}$	March	$17\cdot4^{\circ}$
December	$62\cdot4^{\circ}$	December	$37\cdot8^{\circ}$	December	$24\cdot6^{\circ}$
Mean	$65\cdot9^{\circ}$	Mean	$46\cdot1^{\circ}$	Mean	$19\cdot8^{\circ}$

At Cannes the highest maximum temperature was met with in November, while in April at Kew, with a difference of 13° between the two stations for these two months. The highest monthly maximum varies at Cannes, from 69° in November to $64\cdot2^{\circ}$ in December, and at Kew from 56° in April to $37\cdot8^{\circ}$ in December; the mean at both places for the winter, $65\cdot9^{\circ}$ and $46\cdot1^{\circ}$, gives a difference of no less than $19\cdot8^{\circ}$ in favour of Cannes, showing to what extent the temperature may vary between the two places.

Temperature of the air at night, or before sunrise—Minima.—We must now take into consideration the *lowest* readings of the thermometer, beginning with those observed within the frame, and therefore independent of radiation.

The mean winter monthly minimum temperature at Cannes ranged from $39\cdot2^{\circ}$ in February to $48\cdot8^{\circ}$ in April, with a mean of $44\cdot4^{\circ}$ for the whole season. These six winter months would succeed each other as follows in a

table beginning with those exhibiting the lowest temperature. I have appended a similar Table for the mean minima of thirteen seasons in London from Mr. Strachan's Table :—

MEAN MONTHLY MINIMA AT CANNES (1874-75)		MEAN MINIMA IN LONDON (THIRTEEN SEASONS)		EXCESS AT CANNES	
February	39·2°	January *	34·6°	February	2·2°
December	40·3°	March	36·7°	December	3·3°
March	44·6°	December	37·0°	March	7·9°
January	46·2°	February	37·0°	January	11·6°
November	47·5°	November	38·1°	November	9·4°
April	48·8°	April	42·6°	April	6·2°
Mean	44·4°	Mean	37·7°	Mean	6·8°

The coldest month at Cannes was February, while January comes fourth on the list, which is colder than April only by 2·6°. The coldest night at Cannes that year was from December 23 to December 24, when the thermometer on the grass registered 23° F.

On Wednesday morning, February 17, at 8.40 A.M. the weather was calm and very hazy, and a sudden fall of the barometer took place from 30·02 inches at midnight to 29·88 inches. At 10.30 A.M. there was a hailstorm with thunder; snow began to fall at 6.45 P.M. that same day, attended with lightning and thunder, and by 11.30 P.M. in the night there was 1·2 inch thick of snow on the hard high road, while snow was still coming down. The next morning snow and rain set in together, and the country exhibited the most unusual appearance of a real winter landscape. The meadows, olive trees, and houses were all decked with white, and, of course, the high road was a deep slough. A fall of snow is quite an unexpected occurrence on the Mediterranean coast; it was especially remarkable in the present instance from its being accompanied with lightning and thunder.

Let us now consider the minima at Kew last winter. The month of December (which in Mr. Strachan's tables

exhibits in London a mean minimum temperature for thirteen seasons of 37°) was much colder than usual last winter, when the mean minimum fell to 29.4° . Then followed a rise, between December and January, to 40° , or 5.4° higher than the average, and the other months were respectively warmer than the average of thirteen seasons as observed in London; so that the mean for the six months last year at Kew, and for thirteen years in London, were nearly the same. Of course, there must be a difference of from 2° to 4° between the temperature in London and at Kew (during the coldest part of the winter), London being the warmest.

If we now turn our attention to the minima as registered last winter at Cannes, and during the corresponding period at Kew, these winter months will succeed each other as follows, beginning with those exhibiting the lowest minima :—

MINIMA AT CANNES FOR 1874-75		MINIMA AT KEW FOR 1874-75		EXCESS AT CANNES	
February	39.2°	December	29.4°	November	10.6°
December	40.3°	February	31.4°	December	10.9°
March	44.6°	March	35.5°	January	6.2°
January	46.2°	November	36.9°	February	7.8°
November	47.5°	April	38.4°	March	9.1°
April	48.8°	January	40.0°	April	10.4°
Mean	44.4°	Mean	35.3°	Mean	9.2°

The month of December, the coldest at Kew, was the coldest but one at Cannes; the difference between December and February at Cannes only amounts, however, to 0.9° . The cold, throughout the winter, was not nearly so sharp at Cannes as at Kew, the former station exhibiting a mean minimum temperature higher than the mean minimum temperature at Kew by 9.2° .

The extreme minima in every month, or highest degree of cold registered in the frame (in the absence of radiation although with free access of air), were as follows :—

EXTREME MINIMA AT CANNES.

December	.	.	.	.	29·8° ¹
February	.	.	.	.	31·4°
January	.	.	.	.	33·4°
March	.	.	.	.	37·4°
November	.	.	.	.	39·2°
April .	.	.	.	.	42·8°

I have but a few words to say respecting the night temperature as recorded between eleven o'clock and midnight. The readings of the dry-bulb thermometer on a cold night are rather high, from the circumstance that the thermometer is in a box which, although perforated with many large holes, and frequently opened, still retains a small quantity of heat. This objection does not hold good in the morning, as by that time the temperature in the box has cooled down to that of the air. On the coldest nights the readings in the box were on some occasions perhaps 1° F. too high: the wet-bulb thermometer being placed under the same circumstances, this difference does not affect the observations for the degree of moisture.

The main point of interest refers to the difference of temperature between the hours of eleven and twelve at night, and the minima as recorded on the next morning.

The following table exhibits plainly the mean weekly extent of cooling of the air (independent of radiation) from between eleven o'clock P.M. and midnight, until the temperature rose again in the morning:—

¹ On the morning of December 23, my minimum thermometer being on the grass, I had no record of the coldest temperature in the frame, but from subsequent observations it may safely be concluded that it hardly, if at all, exceeded 29·5°. Thus on December 11, 1875, in the morning the minimum on the grass registered 24·3°, while in the frame the reading of another similar instrument was 33·4°.

Date				Between 11 and 12 at night	Minimum re- corded at 9 A.M.	Difference
October 28 to November	3			57°·2	54°·5	2°·7
November 4 " "	10			55°·2	51°·8	3°·4
" 11 " "	17			49°·2	44°·0	5°·2
" 18 " "	24			50°·2	47°·6	2°·6
" 25 " December	1			48°·5	44°·5	4°·0
December 2 " "	8			50°·8	48°·0	2°·6
" 9 " "	15			44°·0	41°·2	2°·8
" 16 " "	22			39°·2	35°·5	3°·7
" 23 " "	29			41°·0	37°·2	3°·8
" 30 " January	5			43°·8	39°·4	4°·4
January 6 " "	12			49°·6	46°·4	3°·2
" 13 " "	19			53°·2	50°·2	3°·0
" 20 " "	26			49°·0	46°·4	2°·6
" 27 " February	2			47°·2	42°·8	4°·4
February 3 " "	9			43°·3	39°·2	4°·1
" 10 " "	16			42°·2	37°·6	4°·6
" 17 " "	23			40°·2	39°·8	0°·4
" 24 " March	2			44°·6	40°·2	4°·4
March 3 " "	9			47°·7	42°·8	4°·9
" 10 " "	16			52°·2	50°·0	2°·2
" 17 " "	23			47°·2	43°·5	3°·7
" 24 " "	30			44°·4	43°·5	0°·9
" 31 " April	6			48°·0	47°·0	1°·0
April 7 " "	13			50°·0	47°·2	2°·8
" 14 " "	20			50°·5	47°·7	2°·8
" 21 " "	27			54°·3	51°·0	3°·3
" 28 " May	4			58°·0	55°·2	2°·8
						Mean 3°·2

There is consequently but a slight difference between the temperature of the air in the middle of the night and the coldest period in the twenty-four hours, which always occurs early in the morning. This difference is found to vary between 0°·4° and 4°·9°, with a mean for the six months of 3°·2°. Considering that the temperatures recorded between eleven and twelve at night are rather too high, as stated above, 2°·8° or 2°·9° would be nearer to the true mean difference. It is, therefore, not so much the increase of cold after midnight which causes the fall of temperature observed in bedrooms in the morning, as the persistence of the cold felt in the early part of the night. Still, there is a slight increase of cold after midnight,

which of course is so much added to the cooling influence in bedrooms.

Relative Humidity of the Air.

I have on the present occasion departed slightly from the usual arrangement adopted in this enquiry, and entered the observations *weekly* in the same form as I have found them reported at Kew, or from Wednesday to Wednesday. The months do not, therefore, begin and end with the first and last day, the object of this alteration being to allow us to examine into the hygrometric condition of the air weekly as well as monthly.

The table at p. 56 shows the mean weekly temperature and relative moisture as recorded at nine A.M. and between eleven and twelve at night, together with the relative humidity at Kew observed at ten A.M.

The months would succeed each other as follows, from the dampest to the dryest:—

	Cannes	Kew	Excess of dryness at Cannes
December	80·7	88·9	8·2
March	76·4	78·7	8·2
January	75·1	88·3	13·2
April	73·8	75·1	1·3
February	71·8	87·0	13·2
November.	68·6	87·1	18·5
Mean	74·4	84·2	10·4

We conclude that the mean excess of dryness at Cannes over the mean dryness at Kew amounted to 10·4°, the range being from 0° to 100°. This remark applies of course to the moisture in the air in the form of vapour, and not to condensed moisture or rain.

The month of December was the dampest at both places, while November was the dryest at Cannes, and April the dryest at Kew. November was, indeed, much dryer at Cannes than at Kew, the difference being repre-

CANNES					Kew
9 A.M.			Between 11 and 12 night		10 A.M.
Date	Temperature	Relative humidity	Temperature	Relative humidity	Relative humidity
Oct. 28 to Nov. 3	61·5	74·5	57·2	75·2	88·1
Nov. 4 " " 10	59·8	66·3	55·2	67·7	89·3
" 11 " " 17	51·8	69·5	49·2	72·1	79·6
" 18 " " 24	52·8	64·1	50·2	68·2	91·4
Mean . .	56·5	68·6	52·9	70·8	87·1
Nov. 25 to Dec. 1	49·2	85·7	48·5	86·5	88·7
Dec. 2 " " 8	51·2	86·9	50·8	86·8	86·9
" 9 " " 15	45·0	83·1	44·0	80·4	86·7
" 16 " " 22	41·2	75·7	39·2	80·2	87·0
" 23 " " 29	43·3	71·9	41·0	73·2	95·4
Mean . .	46·0	80·7	44·7	81·4	88·9
Dec. 30 to Jan. 5	42·8	78·5	43·8	78·6	90·9
Jan. 6 " " 12	50·0	76·5	49·6	82·2	90·9
" 13 " " 19	53·0	74·2	53·2	76·2	89·0
" 20 " " 26	49·8	71·2	49·0	70·3	82·4
Mean . .	48·9	75·1	48·6	76·8	88·3
Jan. 27 to Feb. 2	49·2	71·6	47·2	69·0	87·4
Feb. 3 " " 9	45·0	69·2	43·3	76·3	90·0
" 10 " " 16	43·3	69·9	42·2	82·3	89·0
" 17 " " 23	43·5	76·6	40·2	80·7	81·7
Mean . .	45·2	71·8	43·2	77·1	87·0
Feb. 24 to Mar. 2	44·4	79·6	44·6	81·9	90·0
Mar. 3 " " 9	49·0	81·2	47·7	87·2	86·4
" 10 " " 16	54·0	81·5	52·2	77·9	82·4
" 17 " " 23	51·2	66·8	47·2	72·0	66·9
" 24 " " 30	52·0	72·9	44·4	77·6	67·6
Mean . .	50·1	76·4	47·2	79·3	78·7
Mar. 31 to Apr. 6	33·4	75·2	48·0	81·2	71·0
Apr. 7 " " 13	55·8	74·5	50·0	81·5	84·1
" 14 " " 20	55·6	69·4	50·5	84·0	75·1
" 21 " " 27	58·8	76·5	54·3	86·1	68·3
Apr. 28 to May 4	63·5	73·4	58·0	89·5	76·9
Mean . .	57·4	73·8	52·1	84·5	75·1

sented by $18\cdot3^{\circ}$: the driest week at Cannes, from November 18 to November 24, exhibiting a relative degree of moisture of $68\cdot6^{\circ}$, corresponds to the driest week but one at Kew, with a relative humidity of $87\cdot1^{\circ}$. The dampest week at Cannes ($86\cdot9^{\circ}$) was from December 2 to December 8, while at Kew the dampest week was from December 23 to December 29 ($95\cdot4^{\circ}$). Of course the degree of atmospheric humidity depends very much on the winds. Should a strong mistral (north-west wind) blow for several days in succession, the degree of humidity in the air will be very low, so that the driest weeks during the season at Cannes will in general be those during which the north-west wind prevails.

There were no fogs at Cannes in the winter, but on rare instances a slight mist was visible limiting the horizon at sea; while on a few occasions the tops of the hills, at some little distance at the back of the town, were lost sight of in the clouds. These hills rise to a height of from 750 to 800 feet.

Temperature of the Sea at the Surface.

	Highest	Lowest	Mean	Number of observations
November	66 \cdot 5	57 \cdot 5	60 \cdot 4	15
December	59 \cdot 2	52 \cdot 3	55 \cdot 6	16
January.	57 \cdot 5	54 \cdot 3	55 \cdot 8	17
February	56 \cdot 6	52 \cdot 3	54 \cdot 5	11
March	57 \cdot 2	54 \cdot 5	55 \cdot 8	19
April	63 \cdot 2	54 \cdot 5	58 \cdot 5	22

The mean monthly temperature of the sea at the surface was highest in November, $60\cdot4^{\circ}$, and lowest in February, $54\cdot5^{\circ}$; there were, however, but $5\cdot9^{\circ}$ between the extremes. In March and April the temperature gradually increased, the mean in March being the same as in January, $55\cdot8^{\circ}$, and in April it rose to $58\cdot5^{\circ}$. The extreme temperatures are $66\cdot5^{\circ}$, the highest, early in November, and $52\cdot3^{\circ}$ the lowest, in February, being a range of $14\cdot2^{\circ}$.

In October, especially in the early part of that month, sea-bathing can be enjoyed in perfection, and may be continued till the middle or even the end of November. After that time the water feels too cold to be comfortable. About the end of March or beginning of April, bathing can be resumed and carried on till the end of the season, or May. The few who spend the summer on the Mediterranean coast greatly enjoy a daily plunge and a swim in the sea, which may then be considered as tepid.

Compared with the minimum temperature of the atmosphere, we find the sea-water at the surface much the warmest throughout the winter, as may be seen by the following table :—

	Mean minimum temperature of the air at Cannes	Mean temperature of the sea at surface	Excess in sea-water
November	47·5	60·4	12·9
December	42·0	55·6	13·6
January	46·2	55·8	9·6
February	39·2	54·5	15·3
March	44·6	55·8	11·2
April	48·8	58·5	9·7
Mean	44·7	56·8	12·1

Hence it is that an enormous amount of heat becomes absorbed by the Mediterranean during the summer, and is given out in winter. The difference of 12·1° in the water, in excess of the minimum atmospheric temperature, gives but a very inadequate idea of the amount of heat actually stored up in the sea, on account of the very great capacity for heat possessed by water. ‘The pound of water in falling through one degree would yield thirty times the amount of heat yielded by the pound of mercury;’¹ so that the surface-water of the Mediterranean, by falling from 66·5° in November to 52·3° in February, and thereby losing 14·2° of its temperature, must actually supply a very

¹ ‘Heat a Mode of Motion,’ by John Tyndall, p. 137.

large amount of heat. Water is a very bad conductor of heat, and consequently a very small portion indeed of these $14\cdot2^{\circ}$ would disappear by conduction downwards, nearly the whole of this heat being given out into the atmosphere. It follows that the temperature of the air near the Mediterranean, must derive a considerable accession of heat throughout the winter, from that which is stored up by the water during the summer, and this may be considered as one of the most powerful agents to which we are indebted for the comparatively mild winter temperature of the south of France. The house I inhabit at Cannes is situated at about 75 yards from the sea and about 30 feet above it. This proximity to the sea makes its situation rather warmer than other places at a further distance from the water and on the high ground. Hence it is that I have observed in the morning ice and hoar-frost in spots some distance from the sea, while there was no sign of either where I lived. I have also noticed on several occasions, on a still night, that the air close to the sea felt warmer than it did quite near to my house. Of course the proximity of my instruments to the sea must be taken into account as favouring high readings for temperature.

On the Radiation of Heat after Sunset.

A great deal is spoken of the sudden accession of cold, at and immediately after sunset, on the Mediterranean coast, in consequence of the very great radiation of heat. A few words explanatory of this phenomenon may help to make it clear to the mind, although its principle is simple enough to understand. On a bright sunny day a considerable amount of heat is absorbed by the earth and objects exposed to the direct rays of the sun. The earth is a bad conductor of heat; so that the heating power of the sun becomes concentrated over a very thin layer of soil, raising its temperature materially. No doubt some of this heat is converted into movement, mechanical action being in-

variably regarded as a conversion of heat into motion, but the greatest portion of it is given out on a clear night and evolved into space. The radiation of heat from the earth takes place on a bright day just as it does at night, but then the balance is in favour of absorption or gain. Heat is no particular material, but a form of motion—a vibration of an ether permeating not only all solid, liquid, and gaseous bodies, but also space, to an indefinite distance from our planet. Clouds absorb heat from the sun; and on a dull day much of the heat, which would have reached the earth had the weather been fine, becomes arrested and seized upon by the clouds. At sunset, the heat thus in store is given out both on the side which faces the earth and on the opposite surface turned towards space. In addition to this phenomenon the clouds, by opposing a physical obstacle to the passage of heat from the earth, and, in fact, reflecting it back towards its surface, contribute to check the cooling of the earth at sunset: there is, thus, no apparent radiation of heat from the earth on a cloudy evening, which means that there is no perceptible fall of temperature at sunset or later.

On a clear day the heat absorbed by the earth is radiated into space, creating cold; still, this mass of heat does not pass entirely through the air without exerting some influence on its temperature.

If instead of clouds we have a roof, or a shelter of any kind—a mere awning, for example—the radiation, which always takes place in a vertical direction, will be checked or arrested, and the temperature thereby prevented from falling to the same degree as it would in the open air. The simple presence of humidity in the air, or water suspended in the form of vapour, will oppose itself more or less to radiation. A few observations I made one evening at Cannes on the fall of temperature at sunset are here-with subjoined. On November 4, 1874, the readings of three thermometers were observed, one of which, a thermometer with a blackened bulb, was hanging from a rod projecting horizontally from the railing of a balcony

situated on the first-floor of the house I was inhabiting, and facing the south. No object intervened between the instrument and the sky. Two other thermometers, one with a dry bulb and another with a wet bulb, were placed on the north side of the house in a mahogany perforated box, the arrangement being that adopted by Casella. On that day, November 6, at 4.5 P.M., the sun was a few degrees above the mountains of the Esterel, with a perfectly clear horizon, temperature 71.6° in the sun; the air was calm, not a cloud was visible in the blue sky. The observations I made are entered in the subjoined table. The lower limb of the sun disappeared behind the horizon at 4.27 P.M., when the temperature had fallen from 71.6° to 62.6° , or 9° F. in the course of twenty-two minutes. At 4.40, or a few minutes after sunset, the temperature was 1° higher, probably from a slight increase of moisture-checking radiation; while at 6.27, say about two hours after sunset, the black-bulb thermometer, exposed freely to the air, had fallen to 59° , or the temperature registered was 12.6° colder than at 4.5 P.M., and 3.6° below what it was at sunset. By 11.30 at night the temperature had fallen to 53.6° , or 18° below the reading of the instrument at 4.5 P.M., and 10° lower than it was at sunset.

Time of experiment	Southern exposure	Northern exposure		Relative moisture
	Black bulb free	Dry bulb	Wet bulb	
Nov. 6 4.5 P.M. before sunset	71.6	64.2	55.4	56.0
" 4.27 sunset	62.6	—	—	—
" 4.40 after sunset	63.5	60.8	54.0	62.8
" 6.27 "	59.0	57.2	52.2	70.2
" 11.30 (night)	53.6	55.4	11.8	64.4

A repetition of this same series of observations would, no doubt, have given interesting results. So far, however, they illustrate the remarkable cooling of the temperature of the air during and after sunset, together with the increase of moisture in the air after sunset, and show the import-

ance for invalids either of being in-doors at that time of the day, or of putting on some extra clothing if out-of-doors and lightly clad at that hour.

With these remarks I beg to conclude. I had commenced by observing that my subject had lost much of its former interest from the extent of its literature; still, the faithful record of personal experience given in a plain, and I hope also a clear, form, may perhaps not prove an entirely useless addition to the many other writings on the Climate of the South of France and its Medical Aspect.

